Station Paper No. 78 June 1957

Some Results of Seeding and Fertilization to Improve Southern Forest Range

by

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Grateful acknowledgment for assistance is made to John S. Williams and Reynold F. Suman, formerly of the Southeastern Forest Experiment Station; Claude H. Rainwater, Jr., formerly of the Animal and Poultry Husbandry Branch, USDA; and Otho M. Hale, Assistant Animal Husbandman, University of Georgia Coastal Plain Experiment Station.

This is a cooperative investigation by the University of Georgia Agricultural Experiment Stations, Coastal Plain Experiment Station, and the following agencies of the U. S. Department of Agriculture: Southeastern Forest Experiment Station, Forest Service; Forage and Range Section, Field Crops Research Branch, Agricultural Research Service; and Animal and Poultry Husbandry Branch, Agricultural Research Service.

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INTRODUCTION

Several million acres of cutover longleaf-slash pine forests have long contributed to the beef cattle industry of the Southeast. These forests often provide forage for cattle through the entire timber rotation. Although large quantities of forage may be produced, beef production is limited because the infertile soils do not produce high quality native forage palatable to cattle. Quality, quantity, and palatability of forage could seemingly be improved through the application of fertilizer and replacement of the less desirable species with more nutritious tame forage plants.

The tests reported herein were an endeavor to improve forest range by eliminating the relatively low quality native forage and seeding to desirable tame pasture plants adaptable to the coastal plain region. Improvement practices involved land preparation, fertilization, and artificial seeding. Treatment was evaluated by measuring the response of tame and native forage plants, pine seedling establishment and survival, and animal weight changes.

Several fertilization and reseeding studies have been conducted in the pine forests of south Georgia and north Florida. Blaser and Boyd (1) established clovers and grasses in virgin sods of the flatwoods by burning the herbaceous vegetation, fertilizing, seeding, and controlling competing vegetation by grazing. More recently, Killinger (5) showed that mineral and protein content of wiregrass was increased after the range had been burned and complete fertilizers and lime applied.

Work by Burton and Mathews (3) produced valuable information on proper species, land preparation, and fertilization and liming needed for seeding Georgia flatwoods. Louisiana white clover, common lespedeza, Dallisgrass, and carpetgrass were outstanding species on sandy soils. A relatively high level of fertility was indicated for best growth of white clover and Dallisgrass, whereas common lespedeza and carpetgrass responded well with relatively low fertility. Halls and Suman (4) showed that Louisiana white

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clover, carpetgrass, and Dallisgrass could be established without tillage in longleaf-slash pine forests when litter was removed by burning and when fertilizer and lime were applied. Carpetgrass stands improved with close grazing, whereas Dallisgrass declined. Nearly all native species were eliminated.

Studies by Woodhouse and Lovvorn (7) in North Carolina and by Burton and Mathews (3) in Georgia suggested that big trefoil was a legume well adapted to the flatwoods of these states. The latter studies showed that native vegetation did not compete seriously with big trefoil, which had the great merit of affording green forage throughout the year.

Observations from exploratory tests by the authors at Alapaha, Georgia, revealed the excellent possibilities of big trefoil and Dallisgrass for improving forest range under a relatively high level of fertility. Dallisgrass was successfully introduced into flatwoods by seeding alone or by overseeding on stands of big trefoil. Heavy trampling and close grazing during establishment were not detrimental to big trefoil or Dallisgrass. Both species were highly palatable, and had a long season of growth. When beyond the seedling stage, big trefoil made acceptable regrowth following accidental burning.

Carpetgrass and common lespedeza are widely distributed and well adapted to the coastal plain of Georgia (6). Carpetgrass is fairly palatable but when unfertilized is not nutritious enough to produce finished animals. Common lespedeza is the most widespread legume found with carpetgrass on unimproved flatwoods. Stephens (6) describes it as furnishing excellent feed from early July to the first killing frost. Common lespedeza reseeds well, and in mixtures with carpetgrass furnishes good grazing.

Burton and Mathews (3) indicate that although common lespedeza will grow on unfertilized soils, better growth is obtained when potassium and phosphorus are applied. Working with carpetgrass, Blaser and Stokes (2) showed that light applications were instrumental in promoting greater yields. Accordingly, carpetgrass and common lespedeza with a relatively low rate of fertilizer seem an excellent low-cost combination which owners with limited means could logically use to improve native ranges for grazing.

These studies prompted the selection of a grass-legume combination of carpetgrass and common lespedeza to be tried at a fairly low rate of fertility in the present experiment. Plants selected for comparison at a higher rate of fertilization were Dallisgrass and big trefoil.

THE AREA

The 40-acre study area is located near Alapaha in the upper portion of the "flatwoods" section of the Georgia coastal plain. The terrain is nearly level, with 0- to 2-percent slope, and an elevation of 293 feet. The three main soil types are Lakeland loamy fine sand, Lynchburg loamy fine sand, and Plummer sand. These soils are well drained, moderately well drained, and very poorly drained, respectively. All soils are strongly acid and inherently low in fertility.

The average frost free season extends from March 10 to November 17. Average annual precipitation is 48 inches. Precipitation in excess of 0.01 inch occurs on the average 100 days throughout the year, and rainfall in excess of 0.50 inch for 32 days in each year. Most frequent showers and heaviest rainfall normally take place during July and August. Precipitation records for the study period are included in appendix table 7.

Tree overstory consisted of a medium to heavy stand of pole size longleaf and slash pine trees with a few scattered loblolly pines and scrub oaks.[2/] Gallberry was the principal shrub. Scattered throughout were sawpalmetto, staggerbush, runner oak, southern waxmyrtle, huckleberry, and sand blackberry.

Main herbaceous understory species were pineland threeawn, Curtiss dropseed, various bluestems, panicums, carpetgrass, and miscellaneous grasses.

TREATMENTS

Prior to 1949 the experimental area had been periodically burned during the winter. Cattle had grazed the area since 1943. In June and July 1949, a seed tree cutting removed all but approximately six to eight pine seed trees per acre. Debris was piled and the entire area burned over in November. The area was then divided into four 6-acre and four 4-acre range units (fig. 1).

On two of the 6-acre and two of the 4-acre units half of each was double disked with a bush-and-bog harrow to prepare the land and eradicate shrubs; the other half was cut with a Marden rotary brush cutter. The remaining four pastures had no land preparation other than burning.

A "moderate" rate of fertilizer and lime was applied to the four 4-acre units. One ton of lime, 60 pounds of phosphate (P_2O_5), and 60 pounds of potash (K_2O) were spread in December 1949. The same amount of fertilizer was added the following March. Maintenance consisted of refertilization with 60 pounds each of phosphate and potash every fall. These same units were broadcast seeded to big trefoil at the rate of 3 pounds per acre in February, and Dallisgrass at 10 pounds per acre in March 1950.

A "low" rate of fertilizer, 30 pounds per acre each of phosphate and potash, was applied to the four 6-acre units. This basic rate was added annually in the spring. These units were broadcast seeded to common lespedeza and carpetgrass, plants capable of thriving with relatively little fertilizer, at the rate of 5 and 3 pounds per acre, respectively, in March 1950.

EVALUATION OF TREATMENTS

The effectiveness of ground preparation, fertilization, and seeding in improving range condition was evaluated by examination and records of changes in vegetation, and by cattle weight changes.

2/ Common and scientific names of plants are listed in appendix table 8.

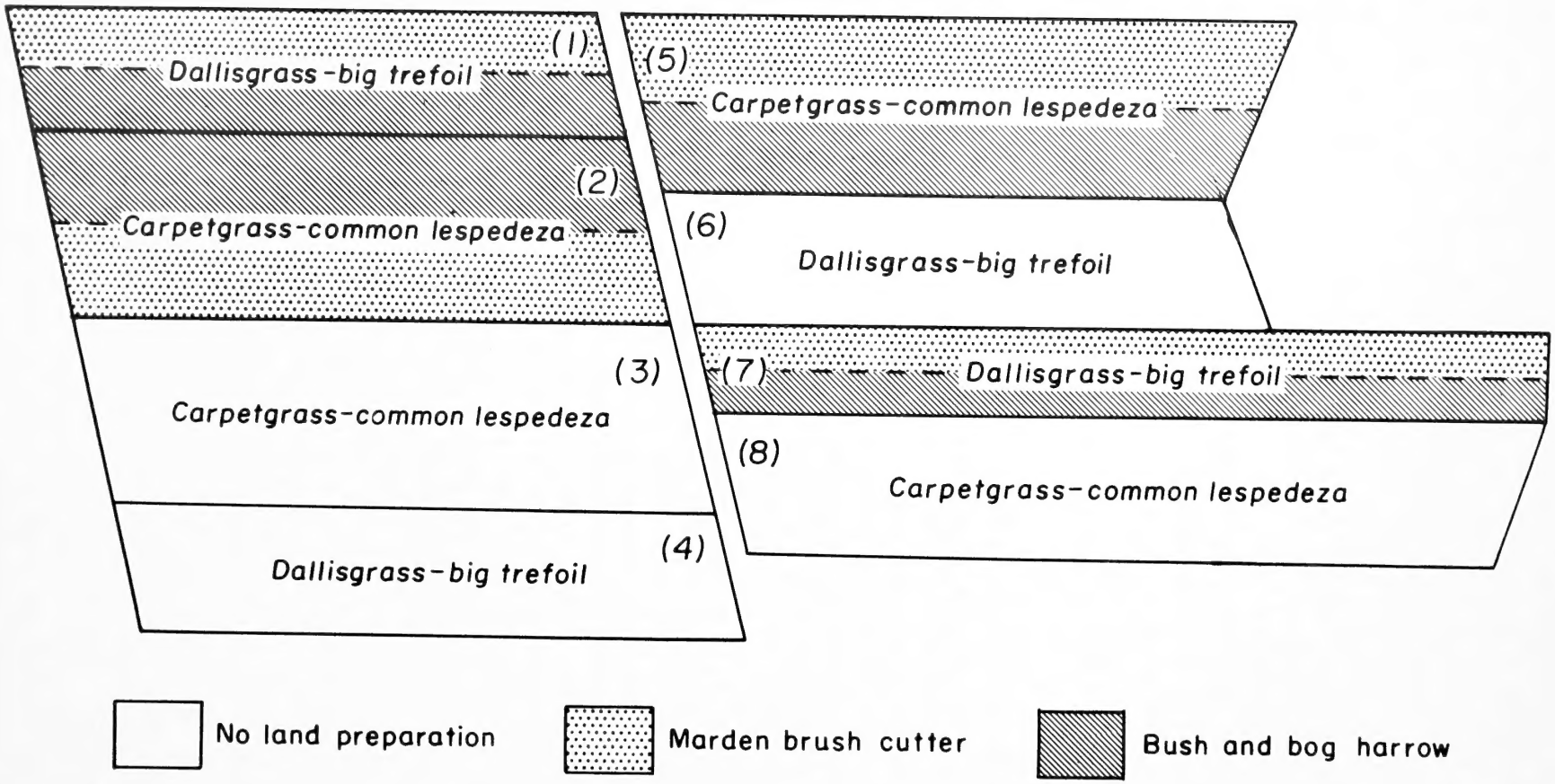

Figure 1.--Experimental tract at Alapaha, Georgia.

Herbaceous ground cover by species was measured by sampling four temporary and randomly distributed 100-square-foot circular plots per acre. Inventories were taken before treatments were applied and again in the fall of 1950, 1951, 1952, and 1954. Periodic observations were made each grazing season to assess the availability and contribution of each tame pasture plant to the cattle diet. In addition each species was rated according to number of plants per unit area. A classification of 1-2 indicated an excellent stand or maximum number of plants per unit area. A 3-4 indicated good stands, 5-6 fair, 7-8 poor, and 9-10 a failure.

Cattle weights were obtained at 28-day intervals from mid-March to mid-October. In 1950, 18 Brahman-Hereford cross heifers moved without restriction through all units for 52 days during the period. In 1951, two Brahman-Hereford cross yearling heifers grazed each unit. From 1952 to 1954 inclusive, animal numbers were regulated at 28-day intervals according to forage availability. A minimum of two animals were left on any one unit during the grazing season. Beginning and final dates of grazing were determined by the stage of growth and availability of forage. Heifers were sprayed for insect control as needed. A mixture of equal parts of steamed bone meal and salt was accessible at all times.

Because investigations were conducted on lands that could presumably be partially or fully stocked with timber, it was deemed desirable to measure pine seedling response to the various treatments. Accordingly, 500 slash pine seed were broadcast on two 1/100-acre grazed and ungrazed plots per unit in January of 1953. Survival counts were taken at beginning and end of grazing season in 1953 and 1954. Success of natural seeding from seed trees was by observation through 1953, after which sixteen 100-square-foot circular plots per unit were inventoried for slash and longleaf pine seedlings.

BEHAVIOR OF RESEEDED FORAGE PLANTS

Dallisgrass

The initial seeding of Dallisgrass on undisturbed sod yielded a meager amount of plants. In an effort to determine whether it might still be possible to get a satisfactory stand of this species, the areas were reseeded in the spring of 1951 and again in 1952. Plant numbers were augmented slightly after each seeding but not sufficiently to produce a desirable coverage. Only a few plants survived after the first year, and by 1954 Dallisgrass had practically disappeared (fig. 2).

Several factors contributed to the poor showing of Dallisgrass on undisturbed sod. Seed often failed to contact the mineral soil. Light grazing the first year after planting did not eliminate competition of native species over most of the area. Carpetgrass soon invaded closely grazed areas and competition from this species not only inhibited Dallisgrass in becoming established, but crowded out a good portion of the existing Dallisgrass. Only in localized areas where slash and debris had been piled and burned and where intense fires of relatively long duration had destroyed the native vegetation did Dallisgrass become established.

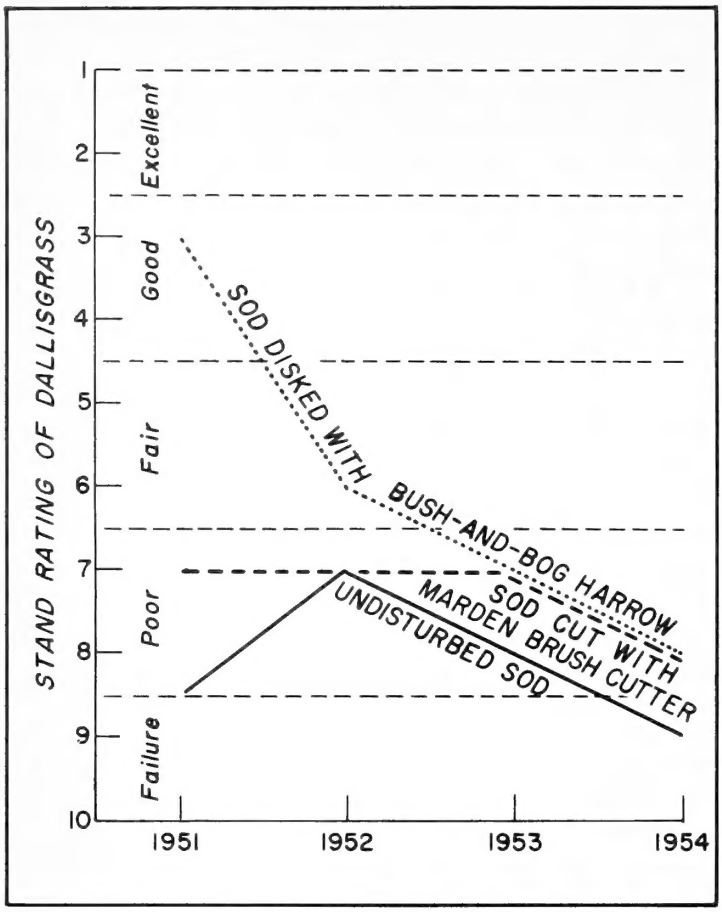

Figure 2.--Dallisgrass establishment was facilitated by land preparation. Infertile soil and competition from carpetgrass hindered perpetuation of this species.

Land preparation definitely aided establishment of Dallisgrass. The degree of success was dependent on the extent to which mineral soil was exposed and competition from native vegetation eliminated. The bush-and-bog harrow completely broke up the sod and practically destroyed all native vegetation; as a result good stands of Dallisgrass were obtained. The effect of the Marden brush cutter on soil and vegetation was less pronounced, and consequently fewer Dallisgrass plants became established. Half of each of these ranges were recut with the Marden brush cutter and reseeded to Dallisgrass in February 1952. This seeding was largely unsuccessful because of competing vegetation.

Good surface soil moisture favored the seeding and perpetuation of Dallisgrass regardless of land preparation. Only a few plants were found where the topsoil was dry for extended periods.

Level of fertility evidently was also a limiting factor and scarcely met growth requirements for good stands of Dallisgrass. Even where good stands of Dallisgrass were originally obtained, the plants diminished rapidly after 1 or 2 years. Decline was hastened by rapidly invading carpetgrass, which was definitely favored by the fertility level and intensity of grazing.

Dallisgrass, being very palatable, was grazed close and when available contributed proportionately large amounts to cattle diet. Amount consumed by cattle was in direct proportion to coverage. During the year when Dallisgrass was most prevalent, it provided substantial cattle feed; by 1954 it was a minor constituent of cattle diet.

Big Trefoil

This legume was successfully introduced into all range units. Seedling establishment and survival on undisturbed soil equaled that where sod was disked or cut and native vegetation wholly or partially eliminated (fig. 3). The most important factor favoring the seedlings was soil moisture. Excellent stands were obtained in the lower portions of each unit, where surface soil was generally moist, but there were fewer plants on the upper, drier areas.

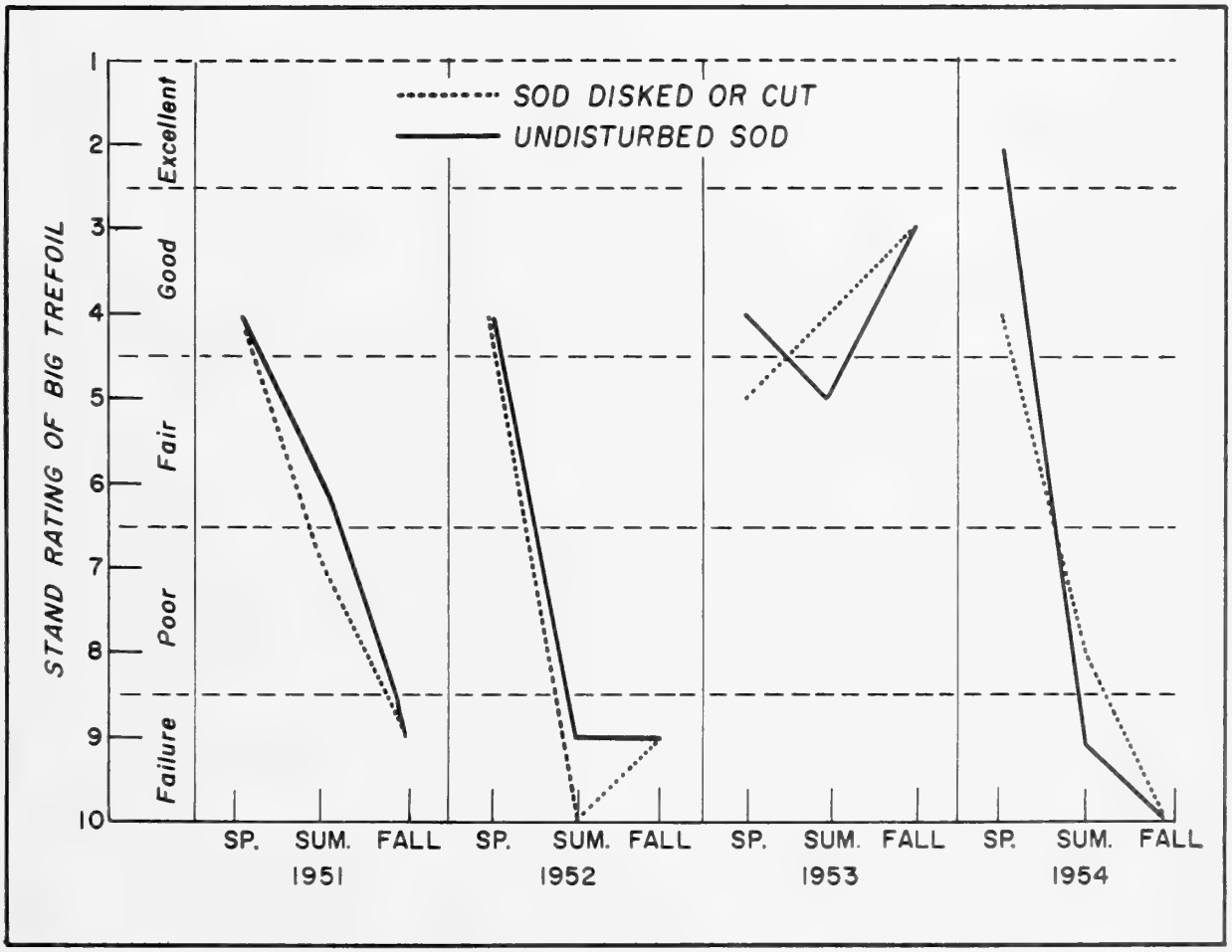

Figure 3.--Big trefoil was readily established and made good growth during the spring. Hot dry weather and disease practically eliminated top growth. With good soil moisture, many plants persisted and made excellent growth during the summer.

Following initial establishment, however, big trefoil had an erratic, seasonal production dependent upon temperature, soil moisture, and incidence of disease and insects. In 1951, this plant made good spring and summer growth. Dry weather and severe attacks of disease and insects in August and September destroyed the top growth of nearly all plants.

Plants were particularly susceptible to black patch fungus and the summer blight caused by Rhizoctonia solani. Lesser damage was caused by the fungus Sclerotium rolfsii and the leafspot Cercospora loti. Many plants were severely damaged or killed by the three cornered alfalfa hopper (Spissistilus festinus).

Destruction of top growth was permanent for plants on the drier sites, but roots survived in moist areas and many plants recovered during late fall. In December, the drier sites were reseeded. Recovery of old plants on moist sites and establishment of new seedlings on the drier sites afforded good stands by the spring of 1952. Disease again became prevalent early in the season, and by July top growth of most plants had been destroyed. The younger, more recently seeded trefoil was least affected. Favorable rainfall during August permitted a good many plants to recover.

Fair to good stands of big trefoil prevailed in the spring of 1953. Above normal precipitation provided favorable soil moisture conditions for abundant growth. Disease and insects were prevalent and much topgrowth was destroyed but enough plants recovered to furnish fair to good stands throughout the summer. Heavy precipitation in September accompanied by a lessening of disease brought forth abundant growth so that stand ratings in October were superior to those at any other time during the year.

These good to excellent stands carried through the spring of 1954. Disease was prevalent by May and greatly increased by the latter part of June. Extremely hot dry weather persisted throughout the summer and fall. By late July, about 90 percent of big trefoil plants appeared dead. Observations in late October showed no evidence of recovery.

Big trefoil was very palatable and supplied a good portion of livestock feed. When abundant and in a healthy growing condition it contributed more feed than any other single species. The tendency for it to die back during late summer and early fall made it undependable as a source of feed. With reseeding, it may offer a valuable source of feed during spring and early summer, especially on moist sites.

Carpetgrass

Seedings of carpetgrass were not successful on undisturbed sods the first year because native bunchgrasses were not grazed close enough (fig. 4). These units were burned again in January 1951, seeded in the early spring, and grazed closely by heifers during the summer. In 1952, good stands of carpetgrass were present and in 1953 it covered most areas continually and closely grazed. In portions of the units where grazing had been light, the native bunchgrasses were not eliminated, and carpetgrass did not take over.

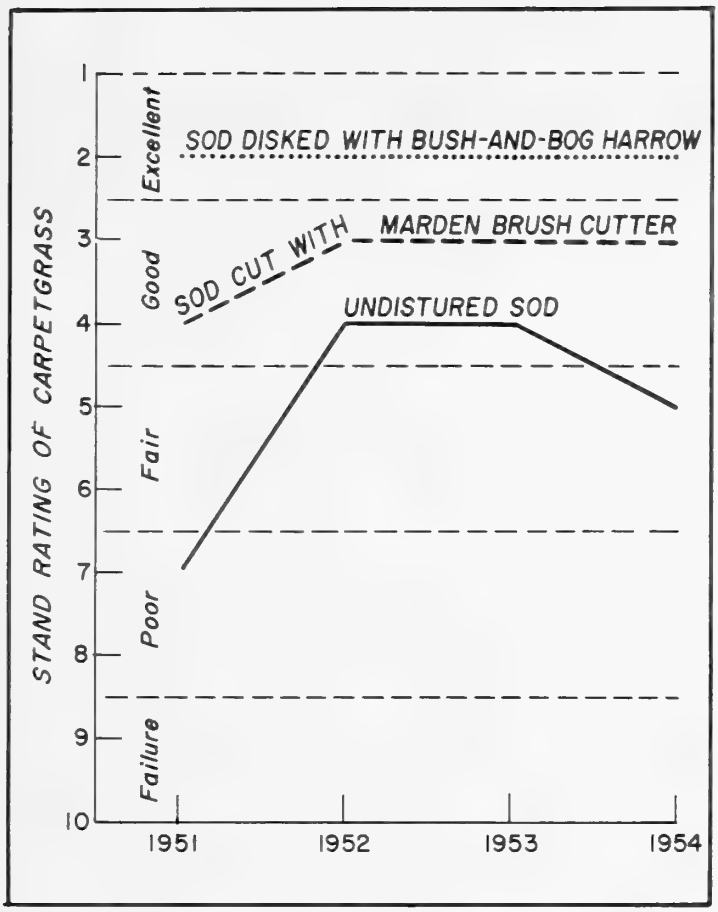

Figure 4.--Carpetgrass establishment was dependent upon land preparation or removal of native grasses by grazing.

Where some form of seedbed was prepared, carpetgrass readily became established (fig. 5). Coverage was in proportion to exposure of mineral soil and elimination of native grasses. Practically a complete cover was obtained on areas effectively treated by bush-and-bog harrow or Marden brush cutter. Where native sod was not destroyed, the invasion of carpetgrass was dependent upon the elimination of native vegetation by grazing.

Cattle grazed carpetgrass very closely. When abundant, this species contributed the greater portion of feed during the late spring, summer, and fall. Other than in early spring immediately after a burn, animals definitely preferred this species to native bunchgrasses. In 1953, carpetgrass contributed less to cattle diet than in 1952 and 1954, but this was due to the abundance of common lespedeza. On the other hand, carpetgrass contributed a proportionately large amount of feed in 1954 because growth and production of lespedeza was considerably less than in the previous year.

Common Lespedeza

Seeding of common lespedeza on undisturbed sod immediately following a burn provided very good stands (fig. 6). Even though this annual plant was grazed closely, enough seed were produced each year to perpetuate good stands through 1953. A noticeable reduction occurred during 1954, probably because of severe drought and very close grazing.

Figure 5.--Good stands of carpetgrass were readily established with little fertilization where land was broken.

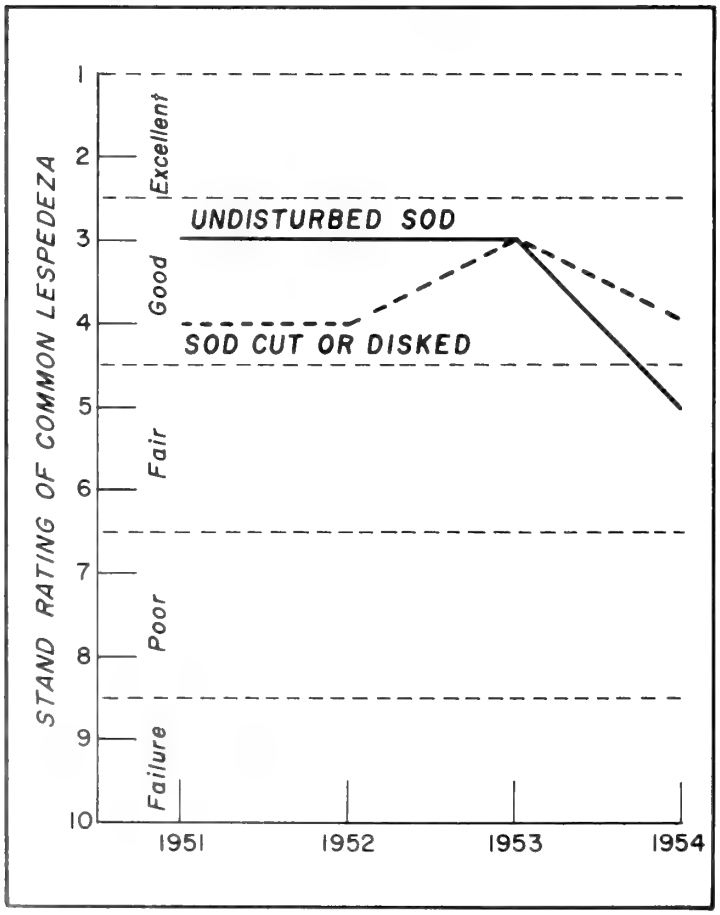

Figure 6.--Good stands of common lespedeza were readily established and maintained, although decreases were noted during the drought of 1954.

Land preparation was not beneficial to the seeding of lespedeza. In fact, stands generally were poorer on the disturbed sods. No difference was discernible between areas gone over with bush-and-bog harrow or brush cutter. Good stands were extended through 1954, though plants diminished slightly during the drought of 1954.

Lespedeza was eatenly readily by cattle and, depending upon its abundance in relation to other species, contributed a good share of the cattle feed. In the summer of 1951 it furnished the greater portion of feed where sod was undisturbed and carpetgrass was scarce. However, on units where sod was disked or cut and carpetgrass was plentiful, lespedeza production was considerably less. The trend in use of lespedeza was similar on all units after 1951: it was very productive in the spring and early summer but contributed little during October, although in 1953 production held up well through the entire season; in 1954, even though stands were reduced and growth was curtailed, the plants furnished feed throughout the season.

EFFECT OF LAND PREPARATION AND FERTILIZATION ON NATIVE VEGETATION

Grasses

Native grasses comprised the greater portion of herbaceous vegetation at the beginning of the study in 1949. The degree and rapidity with which these species were eliminated the next few years depended upon the type of land preparation (table 1).

On units where sod was undisturbed, grazing tended to eliminate all grasses other than the sod-forming carpetgrass which had previously invaded localized areas. Light grazing the first year had a spotty effect on pineland threeawn, but repeat burning and close grazing later on diminished this plant on all units. Without burning, it subsequently became unpalatable and thus increased in ground cover the next few years. Grazing effects on Curtiss dropseed, trinius threeawn, and miscellaneous grasses were not pronounced the first 2 years, but extended grazing thereafter caused the plants to be less prevalent. Bluestems, fairly stable the first 2 years, were reduced to less than one-third of their original ground cover by 1954.

Carpetgrass, of course, was seeded on units fertilized at a low rate, and the plant increased quite rapidly. However, it was not seeded on moderately fertilized units, where it was regarded as an undesirable species. Even though carpetgrass was regarded as a tame forage plant, it was originally present and with heavy grazing it increased very rapidly. Under conditions of this experiment, carpetgrass increased almost as rapidly on unseeded as on undisturbed seeded units.

Sod cutting with a Marden brush cutter reduced native species by approximately one-half. Continued grazing did not reduce the cover of pineland threeawn, but other bunch grasses tended to decrease. Carpetgrass, although not seeded on moderate fertility units, increased at about the same rate and

Table 1.--Changes in ground cover of native grasses under three types of land preparation, two levels of fertilization, and grazing, 1949-1954
(In percent of ground cover)

Species	Level of fertilization	1949	1950	1951	1954
UNDISTURBED SOD					
Pineland threeawn	Moderate	4.7	4.8	1.9	3.8
	Low	4.3	3.3	1.6	3.5
Curtiss dropseed	Moderate	.7	.3	.6	.1
	Low	.3	.4	.5	.1
Bluestems	Moderate	3.8	2.1	3.7	1.1
	Low	4.3	2.4	3.1	1.2
Trinius threeawn	Moderate	1.3	.8	.8	.3
	Low	1.5	.9	1.5	.3
Carpetgrass	Moderate	3.2	3.9	11.2	16.9
	Low	4.7	9.3	11.6	23.0
Miscellaneous grasses	Moderate	3.1	2.9	2.8	2.6
	Low	3.9	2.0	1.0	.8
SOD CUT WITH MARDEN BRUSH CUTTER					
Pineland threeawn	Moderate	3.5	1.8	1.7	2.0
	Low	2.5	1.8	1.4	1.1
Curtiss dropseed	Moderate	1.0	(1/)	.1	(1/)
	Low	.7	.4	1.1	.4
Bluestems	Moderate	3.4	1.3	3.0	.6
	Low	4.0	1.2	1.3	.5
Trinius threeawn	Moderate	1.5	1.1	.6	.3
	Low	2.1	1.1	.8	.4
Carpetgrass	Moderate	3.6	6.3	9.7	17.2
	Low	1.6	6.4	10.1	44.5
Miscellaneous grasses	Moderate	4.6	2.6	1.0	.2
	Low	3.1	2.1	1.6	1.2
SOD DISKED WITH BUSH AND BOG HARROW					
Pineland threeawn	Moderate	3.5	.1	.1	.1
	Low	2.5	.2	(1/)	.5
Curtiss dropseed	Moderate	1.0	(1/)	.1	(1/)
	Low	.7	.1	.1	.2
Bluestems	Moderate	3.4	.2	.6	.3
	Low	4.0	.1	.3	.4
Trinius threeawn	Moderate	1.5	1.0	1.7	.3
	Low	2.1	.9	1.3	.2
Carpetgrass	Moderate	3.6	6.1	7.9	23.7
	Low	1.6	15.8	46.0	50.0
Miscellaneous grasses	Moderate	4.6	4.0	2.1	1.0
	Low	3.1	3.2	1.4	.9

1/ Less than 0.05 percent.

extent as previously noted on the undisturbed sod. However, the Marden brush cutter sufficiently exposed mineral soil so that carpetgrass gained a foothold much more rapidly on the low fertility units seeded to this species.

The bush-and-bog harrow practically eliminated pineland threeawn, Curtiss dropseed, and the bluestems. The decline was less abrupt for trinius threeawn and miscellaneous species, but continued grazing reduced the latter considerably by 1954. This large reduction in native species enabled carpetgrass to attain a greater coverage than was noted on any other units.

Broad-leaved Herbs

A combination of land preparation and fertilization affected the degree of invasion or change in ground cover of broad-leaved herbs. The two species which did not show a decrease on undisturbed soils were hairy trilisa and grassleaf goldaster. The latter was the only species to enhance its position on units fertilized at a low rate. Although other herbs tended to increase the first year, grazing and competition from native and tame grasses reduced them to negligible amounts by 1954 (table 2).

Where the sod was broken, hairy trilisa and grassleaf goldaster were greatly reduced. Other weeds did not become a serious problem with low fertilization, but on the moderately fertilized units several tall-growing weeds invaded and became rather prominent by 1954 (fig. 7). Dogfennel, originally present in small amounts,increased considerably and became the most prominent herb under moderate fertilization where the sod was broken. Otherwise, its occurrence was of minor importance. Other unpalatable species which invaded or increased were goldenrod, camphor weed, and fleabane.

Figure 7.--Left, very few weeds and shrubs remained stable on undisturbed soils where fertilization rate was low. Right, dogfennel and blackberry invaded where sod was broken and fertilization rate was moderate.

Table 2.--Change in ground cover of broad-leaved herbs under three types of land preparation, two levels of fertilization, and grazing, 1949-1954
(In percent of ground cover)

Species	Level of fertilization	1949	1950	1951	1954
UNDISTURBED SOD					
Grassleaf goldaster	Moderate	0.8	1.3	1.5	0.2
	Low	1.2	1.4	3.3	2.9
Hairy trilisa	Moderate	.5	.8	.2	.9
	Low	.4	.6	.3	.4
Dogfennel	Moderate	--	.2	.1	(1/)
	Low	.1	.2	.1	(1/)
Goldenrod	Moderate	--	--	--	.1
	Low	--	--	--	--
Miscellaneous	Moderate	2.4	3.7	1.0	.5
	Low	1.6	2.5	1.3	.4
SOD CUT WITH MARDEN BRUSH CUTTER					
Grassleaf goldaster	Moderate	1.8	0.5	0.6	--
	Low	.9	.7	.5	0.3
Hairy trilisa	Moderate	.7	.8	.2	.4
	Low	.8	.7	.4	.2
Dogfennel	Moderate	.1	.2	.1	4.3
	Low	.1	.2	(1/)	(1/)
Goldenrod	Moderate	--	--	--	.5
	Low	--	--	--	--
Miscellaneous	Moderate	2.8	2.5	.8	1.2
	Low	1.7	2.4	.4	.2
SOD DISKED WITH BUSH AND BOG HARROW					
Grassleaf goldaster	Moderate	1.8	.2	(1/)	--
	Low	.9	(1/)	(1/)	0.1
Hairy trilisa	Moderate	.7	.4	(1/)	.2
	Low	.8	.5	.2	.3
Dogfennel	Moderate	.1	.3	.3	3.0
	Low	.1	.2	--	--
Goldenrod	Moderate	--	--	--	1.1
	Low	--	--	--	--
Miscellaneous	Moderate	2.8	2.6	1.9	.4
	Low	1.7	2.6	.5	.5

1/ Less than 0.05 percent.

Shrubs

Gallberry, sawpalmetto, and staggerbush remained quite stable where sod was undisturbed (table 3). A moderate rate of fertilization caused runner oak and blackberry to increase. The latter, a troublesome thorny shrub, spread greatly and by 1954 comprised approximately 43 percent of the total shrub cover (fig. 8). It was noticeably more dense on moist areas, where it often formed impenetrable thickets and restricted herbaceous growth and livestock grazing.

Figure 8.--Dense thickets of blackberry invaded low moist areas where fertilization rate was moderate.

The Marden brush cutter was of little value in eliminating shrubs. Most all species other than sawpalmetto have extensive underground rootstocks which enabled them to survive the cutting effects of this equipment. The bush-and-bog harrow, however, cut and exposed the rootstocks sufficiently to kill a good many plants (fig. 9). Shrubs that survived the original treatment persisted but spread little during the rest of the study. Blackberry, again an exception, continued to increase on units fertilized at a moderate rate, particularly where soil moisture conditions were favorable.

Table 3.--Change in ground cover of shrubs under three types of land preparation, two levels of fertilization, and grazing, 1949-1954
(In percent of ground cover)

Species	Level of fertilization	1949	1950	1951	1954
UNDISTURBED SOD					
Gallberry	Moderate	4.4	4.1	5.3	3.9
	Low	4.0	4.1	4.1	4.2
Runner oak	Moderate	.8	.6	1.4	1.7
	Low	.3	.5	.1	.4
Blackberry	Moderate	.2	.3	.8	5.8
	Low	.5	.6	.6	.8
Sawpalmetto	Moderate	.6	.8	.2	.4
	Low	.4	.2	.4	.6
Staggerbush	Moderate	.2	.2	.1	.1
	Low	.4	.1	.2	.4
Miscellaneous	Moderate	.5	.7	.9	1.7
	Low	1.2	.9	1.0	2.1
SOD CUT WITH MARDEN BRUSH CUTTER					
Gallberry	Moderate	4.5	2.9	3.2	2.9
	Low	4.2	3.8	5.8	3.4
Runner oak	Moderate	.9	.3	.4	.5
	Low	.8	1.1	.3	.8
Blackberry	Moderate	.2	.8	1.1	5.3
	Low	.2	.2	.4	.4
Sawpalmetto	Moderate	.3	(1/)	.1	(1/)
	Low	.3	.2	.2	--
Staggerbush	Moderate	.2	(1/)	(1/)	(1/)
	Low	.3	(1/)	.1	.2
Miscellaneous	Moderate	1.9	.6	1.2	.3
	Low	.8	.3	.6	.4
SOD DISKED WITH BUSH AND BOG HARROW					
Gallberry	Moderate	4.5	.8	1.3	.8
	Low	4.2	1.2	1.8	1.6
Runner oak	Moderate	.9	.1	.2	.3
	Low	.8	.4	.2	.8
Blackberry	Moderate	.2	.2	1.1	3.3
	Low	.2	.2	(1/)	.1
Sawpalmetto	Moderate	.2	.1	(1/)	(1/)
	Low	.3	.1	.1	--
Staggerbush	Moderate	.2	.1	.1	.1
	Low	.3	(1/)	.2	.1
Miscellaneous	Moderate	1.9	.5	.5	.1
	Low	.8	.3	.4	.3

1/ Less than 0.05 percent

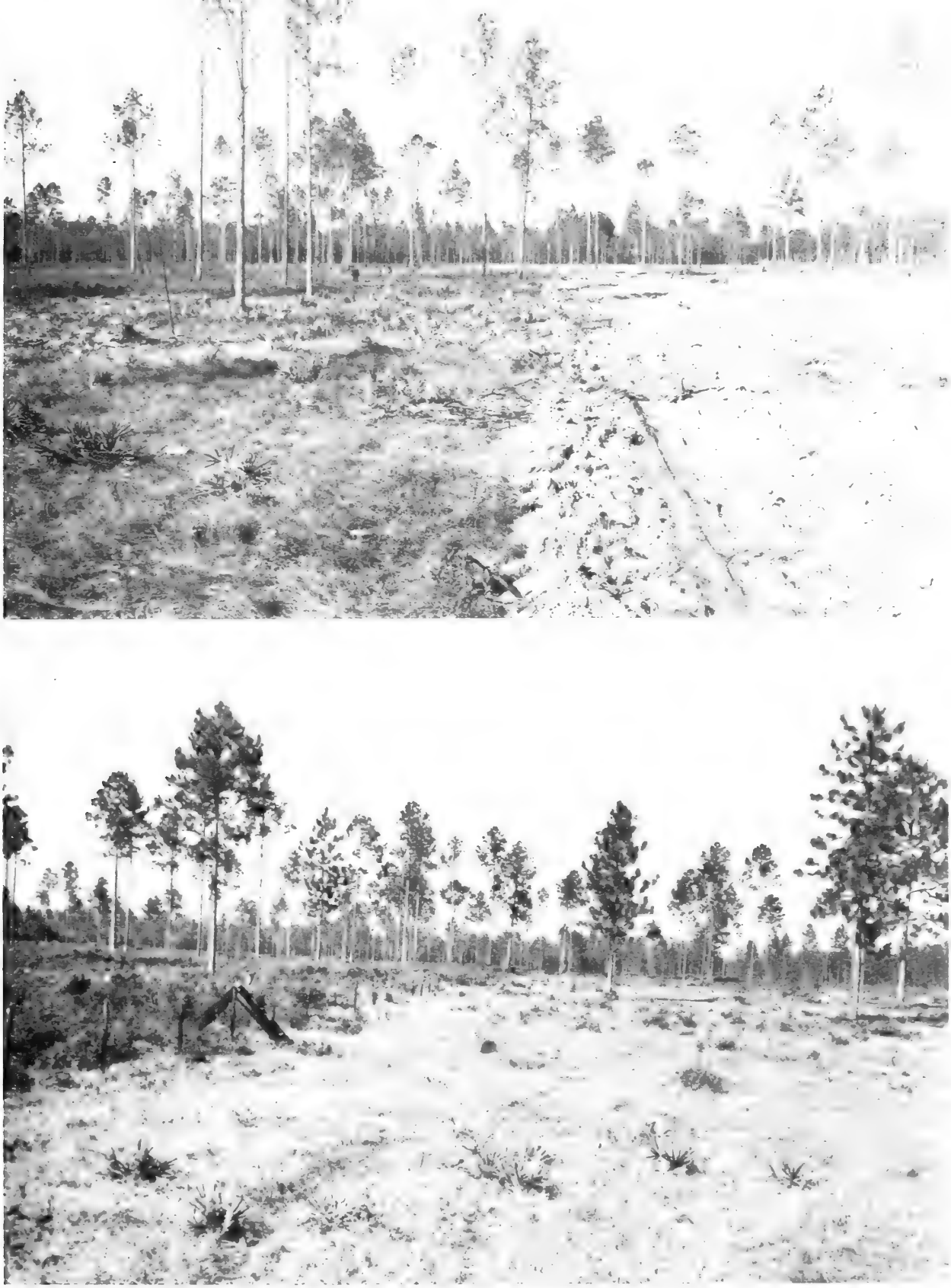

Figure 9.--Upper photo, bush-and-bog harrow destroyed native sod and eliminated most of shrubs on right. Area on left was undisturbed. Lower photo, five years later, very few shrubs or weeds were present on a good carpetgrass sod fertilized at a low rate. Native shrubs had increased in height and blackberry invaded area in left, which had been fertilized at moderate rate.

Pine Tree Reproduction

Neither slash nor longleaf seed trees produced enough seed during 1950 and 1951 to provide for establishment of seedlings. Squirrels ate most of the longleaf seed and prevented establishment of this species. Slash pine cone production increased the third year after seed tree release, as shown below:

Year	Number of cones per slash pine tree
1950	5
1951	8
1952	55
1953	54
1954	49

Slash pine seedling establishment from the 1952 and 1953 seed crops was ascertained by an inventory of sixteen 100-square-foot plots in each unit at the end of the grazing season in 1954 (table 4). As indicated by the percent of plots with live seedlings, establishment was rather sporadic and depended largely upon the number of seed trees. Best stocking was obtained in the series of units 1 through 4, where slash pine seed trees were most prevalent (fig. 10). Poorest stocking was found in units 7 and 8, where there were very few seed trees. With ample seed source, a good number of young slash pine seedlings became established and survived the first year of grazing.

Figure 10.--Young slash pine became established where seed source was ample. Heavy grazing subsequently eliminated many of the seedlings shown here.

Table 4.--Slash pine seedling establishment from natural seed source, 1954

Condition of sod	Level of fertility	Pasture number	Slash pine seed trees per acre	Plots with live seedlings	Seedlings per acre
			Number	Percent	Number
Undisturbed	Moderate	4	7	81	898
"	"	6	4	56	272
"	Low	3	5	44	680
"	"	8	1	19	109
Cut or disked	Moderate	1	8	81	980
" " "	"	7	3	31	163
" " "	Low	2	7	75	1,280
" " "	"	5	3	44	572

Heavily concentrated grazing killed many young seedlings. Natural seedfall was augmented by scattering 500 slash pine seed per plot in January of 1953. Average numbers of seedlings on grazed and ungrazed plots at the beginning and end of the grazing season were as follows:

Month and year	Grazed	Ungrazed
April 1953	26	36
October 1953	19	38
April 1954	24	57
October 1954	13	37

Since cattle had access to grazed plots approximately one month before seedling counts were made in April 1953, differences in number of seedlings at that time were perhaps attributable to grazing by cattle. Grazing continued to destroy seedlings from April to October. There was a 27-percent decline in numbers on grazed plots, whereas seedling numbers were maintained on ungrazed plots.

Natural seedfall during the winter of 1953-1954 distributed additional seed on these plots and contributed seedlings from 1953 to the spring of 1954. Heavy mortality of seedlings took place during the hot dry summer and fall of 1954. Seedling numbers were reduced on all plots, but the least reduction occurred on ungrazed plots. By October 1954, the ungrazed plots had nearly 3 times as many 1- and 2-year-old slash pine seedlings as the grazed plots.

CATTLE PERFORMANCE AND ECONOMIC RETURNS

Cattle Weights as Influenced by Forage Species

Quantitative evaluation of pasture production was based on allowable animal days of grazing, total animal gains per acre, and conversion of animal weights and gains to total digestible nutrients per acre. Quality of pasture herbage was measured by daily gain per animal (table 5 and fig. 11).

Figure 11.--Representative group of heifers used for evaluating range improvement practices.

Table 5.--Forage production and animal performance, by forage species, treatment, and years

Year	Unit of measure	Carpetgrass-common lespedeza		Dallisgrass-big trefoil	
		Sod cut or disked	Undisturbed sod	Sod cut or disked	Undisturbed sod
1951	Total	572	712	1,148	1,081
1952	digestible	441	566	892	822
1953	nutrients in	507	483	666	754
1954	pounds per acre	324	313	692	1,002
Average		461	519	850	916
1951	Allowable	98.0	98.0	147.0	147.0
1952	animal days	70.0	81.7	122.5	119.0
1953	per acre	77.0	74.7	101.5	115.5
1954		60.7	60.7	105.0	129.5
Average		76.4	78.8	119.0	127.8
1951	Total gain	53.8	110.5	178.7	141.6
1952	in pounds	68.3	90.2	143.8	135.0
1953	per acre	71.0	68.5	91.3	102.0
1954		12.7	25.9	90.5	104.5
Average		51.5	73.5	127.3	120.8
1951	Daily gain	.55	1.13	1.21	.97
1952	in pounds	.87	1.10	1.16	1.15
1953	per animal	.93	.90	.90	.88
1954		.21	.43	.92	.80
Average		.66	.89	1.05	.95

Animal performance data indicated quite clearly that range improvement practices had a noticeable effect on quantity of forage produced. Significant differences were observed during most years for all the measures of per-acre production of forage between the relatively low-fertility carpetgrass-lespedeza units and the moderate-fertility Dallisgrass-big trefoil units.

The initial land preparation had little over-all effect on the per-acre measures of forage production. In no case was the yield of beef from harrowed, disked, or cut units significantly different from that on undisturbed units. However, certain relationships existed between beef production and abundance of seeded plants. For instance, on the Dallisgrass-big trefoil pastures which had land preparation, per-acre gains tended to be greater during 1951 and 1952. Since big trefoil stands were very similar, the difference was probably due to better Dallisgrass stands during these years. Conversely, cattle gains were better the following 2 years, 1953 and 1954, on units without land preparation. During this time Dallisgrass stands had become similar between units, but the greater gains can be attributed to the better stands of big trefoil present during spring months.

Forage quality as measured by average daily gain per animal was significantly affected by neither species composition nor fertilizer level. But here again, certain similarities were apparent. Daily animal gains were closely associated with the stands of Dallisgrass. On disked or cut units, both Dallisgrass stands and daily gains per animal were best in 1951. When Dallisgrass became less prevalent the following years, daily gains dropped perceptibly. On units without land preparation, daily gains were also best during the year that Dallisgrass was most prevalent. From 1952-1954, daily gains per animal and Dallisgrass stands were both slightly better on units with land preparation.

Similar relationships were evident in the carpetgrass-lespedeza units. Where land had been disked or cut and native grasses practically eliminated, only a limited amount of forage was available during the spring of 1951. Per-acre and per-animal gains were relatively poor. However, units without land preparation but burned the previous winter possessed an abundant native forage. This, in addition to good stands of lespedeza enabled animals to make better gains in 1951 and 1952.

Daily gains per animal were similar in all units in 1953, signifying forage quality was approximately the same--the reason being that carpetgrass had become the main grass in all units. The daily gains in carpetgrass-lespedeza units in 1954 were low because extremely dry weather severely reduced forage production. Moderately fertilized pastures were more productive, ample forage was available, and animals made daily gains comparable to the previous year.

Financial Return in Terms of Beef Production

A tabulation of costs and returns indicates that none of the treatments yielded large returns of salable beef. Broadcasting carpetgrass and lespedeza on undisturbed forest soils and applying fertilizer at a low rate was the most economical practice (table 6). Returns based on current price of beef were nearly four dollars per acre per year. Net returns could possibly be increased by eliminating the cost of seeding carpetgrass and permitting this grass to become established naturally.

Table 6.--Average costs for range revegetation practices, and returns from grazing cattle, 1951-1954
(In dollars per acre)

Item	Carpetgrass-common lespedeza		Dallisgrass-big trefoil	
	Land disked or cut	No land preparation	Land disked or cut	No land preparation
Cost				
Seedbed preparation	5.60	0.0	5.60	0.0
Fertilizer	19.00	19.00	38.00	38.00
Lime	0.0	0.0	6.80	6.80
Seed	3.60	3.60	10.50	10.50
Labor	4.00	4.00	4.00	4.00
Total	32.20	26.60	64.90	59.30
Return				
Gross from beef at $0.15 per pound	30.25	42.00	74.97	72.84
Net	1.95	15.40	10.07	13.54

In terms of beef production, land preparation did not pay. Under both moderate and low level rate of fertilization, net returns were greater on land that was undisturbed. Also, weeds were less troublesome on undisturbed soils.

SUMMARY

Range improvement practices were evaluated from 1949 through 1954 for a longleaf-slash pine forest clearcut to seed trees. Carpetgrass and common lespedeza were broadcast seeded on undisturbed soils, and on soils chopped or disked. They were compared with seedings of Dallisgrass and big trefoil on undisturbed, chopped, and disked soils. Annual fertilization was at the rate of 30 pounds per acre of phosphate and 30 pounds of potash on the carpetgrass-lespedeza units and 60 pounds each on the Dallisgrass-big trefoil units.

Treatments were evaluated through response of seeded and native plants, pine seedling survival, and animal performance.

Where native vegetation was destroyed and mineral soil exposed, successful stands of Dallisgrass were established; seedings were unsuccessful on burned undisturbed sod. Under conditions of this experiment, Dallisgrass was crowded out by native carpetgrass in a very few years.

Big trefoil readily became established with or without land preparation. Establishment and survival were dependent to a great extent on moisture. The limiting factor in perpetuating this plant was the prevalence of several insects and diseases which attacked it severely during the summer. The plant was better able to withstand and recuperate from disease when soil moisture was ample. It furnished valuable forage during spring and summer when moisture was sufficient and disease not too severe.

Carpetgrass became the most abundant and important grass for grazing on all ranges regardless of land preparation or seeding treatment. Land preparation did, however, speed up establishment and permit better stands to be maintained.

Seeding of common lespedeza on undisturbed sod, immediately following a burn, provided very good stands. Land preparation did not benefit this species. Lespedeza produced enough seed annually to perpetuate itself, but a severe drought and extremely close grazing thinned out the stand in 1954.

Native grasses responded directly to grazing and land preparation. Bunchgrasses and single stem species decreased with grazing. Land preparation tended to eliminate these species. The sod-forming carpetgrass increased with grazing, particularly where the sod had been broken.

Broad-leaved herbs such as dogfennel and goldenrod became troublesome where sod was broken and pastures moderately fertilized. Grassleaf goldaster increased with grazing on undisturbed soils fertilized at low rate.

Shrubs remained quite stable on undisturbed sods where the fertilization rate was low. The brush cutter was less effective than the bush-and-bog harrow in eliminating shrubs. Blackberry increased greatly on ranges moderately fertilized. It became particularly dense and formed impenetrable thickets where soil was moist.

Slash pine seed production increased the third year after seed tree release. Survival of slash pine seedlings 2 years later was sporadic and incomplete. Grazing destroyed many 1- and 2-year-old seedlings. Adequate pine tree reproduction would be dependent upon more seed trees or a reduction in grazing intensity for 1 or more years following seed dispersal. Longleaf pine seed were nearly all consumed by squirrels.

Animal performance data in TDN production, total animal weight gain, and length of grazing season indicated that fertilization rate had a significant effect on forage production. Forage quality, as indicated by daily weight gain, was closely related to the abundance of seeded forage species such as Dallisgrass.

Economic returns from these trial practices in terms of beef production indicate that initial land preparation did not pay. Seeding of tame forage species on undisturbed sod was more economical. Carpetgrass and common lespedeza on these infertile soils afforded the greatest net return.

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APPENDIX

Table 7.--Monthly precipitation records at Alapaha, Georgia, 1950-1954
(In inches of rainfall)

Month	1950	1951	1952	1953	1954
January	.87	1.31	1.99	3.49	1.33
February	1.30	2.10	4.51	5.79	1.12
March	7.70	8.61	3.35	2.45	1.84
April	2.30	2.63	2.23	4.90	3.38
May	3.48	2.38	3.92	3.26	3.69
June	2.17	3.18	.82	4.66	2.88
July	8.80	5.62	3.75	7.92	1.40
August	5.01	2.89	6.50	7.05	3.18
September	2.16	5.54	5.33	10.21	2.34
October	3.83	.91	1.56	.67	.47
November	2.14	3.85	1.33	.90	1.86
December	3.80	5.57	2.29	8.52	2.99
Total	43.56	44.59	37.58	59.82	26.49

Table 8.--Partial list of plants found on experimental site

Common name	Scientific name
TAME FORAGE PLANTS	
Dallisgrass	Paspalum dilatatum Poir.
Big trefoil	Lotus uliginosus Schkuhr.
Carpetgrass	Axonopus affinis Chase
Common lespedeza	Lespedeza striata (Thunb.) H. and A.
NATIVE GRASSES	
Pineland threeawn	Aristida stricta Michx.
Curtiss dropseed	Sporobolus curtissii (Vasey) Small ex Scribn.
Panicum	Panicum spp. L.
Bluestems	Andropogon spp. L.
Trinius threeawn	Aristida affinis (Schult.) Kunth.
BROAD-LEAVED HERBS	
Grassleaf goldaster	Chrysopsis graminifolia (Michx.) Nutt.
Hairy trilisa	Trilisa paniculata (Walt.) Cass.
Goldenrod	Solidago microcephella (Greene) Bush
Dogfennel	Eupatorium compositifolium Walt.
Camphorweed	Heterotheca subaxillaris (Lam.) Britt and Rusby
Fleabane	Erigeron pusillus Nutt.
SHRUBS	
Gallberry	Ilex glabra (L.) A. Gray
Runner oak	Quercus pumila Walt.
Blackberry	Rubus cuneifolius Pursh
Sawpalmetto	Serenoa repens (Bartr.) Small
Staggerbush	Xolisma fruticosa (Michx.) Nash

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